

REMARKS

In view of the above amendments and the following remarks, reconsideration of the rejections contained in the Office Action of January 4, 2007 is respectfully requested.

By this Amendment, claims 12 and 17 have been amended. Thus, claims 12, 13 and 17-20 are currently pending in the application. No new matter has been added by these amendments.

On pages 3-5 of the Office Action, the Examiner rejected claims 12, 13 and 17-20 under 35 U.S.C. § 103(a) as being unpatentable over Ukrainczyk (US 6,594,419). For the reasons discussed below, it is respectfully submitted that the amended claims are clearly patentable over the prior art of record.

The discussion of the invention provided below makes reference to the specification and figures of the present application. However, these references are made only for the Examiner's benefit, and are not intended to otherwise limit the claims.

Amended independent claim 12 recites an optical fiber coupling part which includes an optical fiber, and at least one GRIN lens fusion-spliced with an end of the optical fiber. Claim 12 also recites that the GRIN lens has an exposed end, and that the GRIN lens has a numerical aperture NA that is larger than a numerical aperture NA_s of a light emitting source. Further, claim 12 recites that the numerical aperture NA is 0.43 or more, and that *a tip part of the exposed end of the GRIN lens is flat*.

Amended independent claim 17 recites an optical fiber coupling part which includes an optical fiber having a numerical aperture NA_f , a first GRIN lens having a numerical aperture NA_1 , and a second GRIN lens having a numerical aperture NA_2 . Claim 17 also recites that a first end of the second GRIN lens is fusion spliced with an end of the optical fiber and a second end of the second GRIN lens is fusion spliced with the first GRIN lens. Further, claim 17 recites that *the first GRIN lens has an exposed end, and that a tip part of the exposed end of the first GRIN lens is flat*. Claim 17 also recites that the numerical aperture NA_f of the optical fiber, the numerical aperture NA_1 of the first GRIN lens, the numerical aperture NA_2 of the second GRIN lens, and a numerical aperture NA_s of a light emitting source are selected to satisfy the formula expressed by $NA_f \leq NA_2 < NA_s \leq NA_1$.

I.

Ukrainczyk discloses a tapered lens fiber which, as shown in Fig. 4, includes a multimode fiber 4 attached to an optical fiber 6. However, Ukrainczyk does not disclose that *the tip part of the exposed end of the GRIN lens is flat*, as required by amended independent claims 12 and 17. As shown in Fig. 2 of the present application, and as explained on page 25 of the replacement English translation, the tip part of the exposed end of the first GRIN lens is flat. Ukrainczyk, however, discloses an optical fiber in which “the tip 16 of the tapered multimode fiber 4 has a radius of curvature” (column 4, lines 1-2). Therefore, Ukrainczyk does not disclose that the tip part of the exposed end of the GRIN lens is flat because Ukrainczyk specifically discloses that the tip of the exposed end of the GRIN lens is curved.

It is noted that on pages 5-6 of the Office Action, the Examiner asserts that either end of the GRIN lens shown in Fig. 4 of Ukrainczyk may be considered a tip, and that the left-hand side of the GRIN lens shown is flat. The Examiner also takes the position that Figs. 2A and 2B of Ukrainczyk show GRIN lenses with two flat tips. In this regard, it is noted that the flat ends of the GRIN lenses referred to by the Examiner (*e.g.*, the left-hand side of the GRIN lens in Fig. 4) are not exposed ends of the GRIN lens, as required by amended claims 12 and 17. Rather, Ukrainczyk discloses that the exposed end 34 (Figs. 2A and 2B) and the exposed end 16 (Fig. 4) both have “a radius of curvature” (column 1, line 61, and column 4, lines 1-2). Therefore, Ukrainczyk does not disclose that the tip part of the exposed end of the GRIN lens is flat because Ukrainczyk specifically discloses that the tip of the exposed end of the GRIN lens is curved.

II.

As noted by the Examiner, Ukrainczyk does not disclose a GRIN lens having a numerical aperture larger than a numerical aperture of a light emitting source, or that the numerical aperture of the GRIN lens is 0.43 or more, as required by independent claim 12. Nevertheless, the Examiner asserted that light sources with very small apertures (less than that of a GRIN lens) are known in the art, and therefore that it would have been obvious for one of ordinary skill in the art to use a small numerical aperture light source with the fiber structure of Ukrainczyk.

In this regard, arguments were included in the response submitted on October 5, 2006 which clearly explained why it would not have been obvious for one of ordinary skill in the art to use a small numerical aperture light source with the fiber structure of Ukrainczyk. However, it is noted that the Examiner did not respond to those arguments in the current Office Action. Therefore, those arguments are re-presented below, as they still clearly indicate why it would not have been obvious for one of ordinary skill in the art to use a small numerical aperture light source with the fiber structure of Ukrainczyk. It is thus respectfully requested that those arguments, re-presented below, be considered by the Examiner.

It would not have been obvious to one of ordinary skill in the art to combine a small numerical aperture light source with the fiber structure of Ukrainczyk. In particular, semiconductor lasers typically used as light sources for optical communication must produce, for example, 1-10 mW of output power in order for effective optical communication to be possible. Such semiconductor lasers also have a radiation full angle at half maximum of 25° to 30°. There is no semiconductor laser known in the art which has a reduced radiation full angle at half maximum (and therefore a reduced numerical aperture) that can meet the power output requirements for optical communication. Therefore, it would not have been obvious to one of ordinary skill in the art to combine a small numerical aperture light source with the fiber structure of Ukrainczyk because such small numerical aperture light sources are not suitable for optical communication.

Ukrainczyk also does not disclose an optical fiber coupling part in which the numerical aperture NA_f of the optical fiber, the numerical aperture NA_1 of the first GRIN lens, the numerical aperture NA_2 of the second GRIN lens, and the numerical aperture NA_s of a light emitting source are selected to satisfy the formula expressed by $NA_f \leq NA_2 < NA_s \leq NA_1$, as required by amended independent claim 17. The formula includes the condition that the numerical aperture of the first GRIN lens is greater than or equal to the numerical aperture of the light emitting source. As discussed above, Ukrainczyk does not disclose that numerical aperture of the first GRIN lens is greater than or equal to the numerical aperture of the light emitting source, and it would not have been obvious to one of ordinary skill in the art to combine a small numerical aperture light source with the fiber structure of Ukrainczyk because such small

numerical aperture light sources are not suitable for optical communication.

Therefore, for the reasons presented above, it is believed apparent that the present invention as recited in amended independent claims 12 and 17 is not disclosed or suggested by the Ukrainczyk reference. Accordingly, a person having ordinary skill in the art would clearly not have been motivated to modify the Ukrainczyk reference in such a manner as to result in or otherwise render obvious the present invention of amended independent claims 12 and 17.

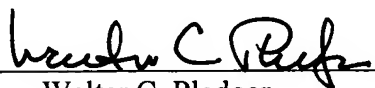
Therefore, it is respectfully submitted that amended independent claims 12 and 17, as well as claims 13 and 18-20 which depend therefrom, are clearly allowable over the prior art of record.

In view of the foregoing amendments and remarks, it is respectfully submitted that the present application is clearly in condition for allowance. An early notice to that effect is respectfully solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

Hiroyoshi MATSUMURA et al.

By: 
Walter C. Pledger
Registration No. 55,540
Attorney for Applicants

WCP/akl/kjf
Washington, D.C. 20006-1021
Telephone (202) 721-8200
Facsimile (202) 721-8250
March 21, 2007